

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions and listings of claims in the application:

LISTING OF CLAIMS:

1. (currently amended) An image display device comprising:
 - a display panel which has a plurality of pixel sections provided in the form of a matrix, each pixel section including at least a pixel for displaying an-a first image for a first viewpoint and a pixel for displaying an-a second image for a second viewpoint;
 - a lens disposed in front of said display panel, said lens being constituted by a plurality of lens elements for refracting light emitted from each pixel to output the light in different directions, each of said plurality of lens elements corresponding to each pixel section, a direction of refracting light from each pixel for said first image being different from a direction of refracting light from each pixel for said second image; and
 - a reflection plate disposed in said display panel or in the rear of said display panel, said reflection plate having surface projections on the surface thereof for reflecting exterior light to said lens;

wherein the focal distance f of said lens is different from the distance H between the surface of said reflection plate and the apex of said lens.

2. (currently amended) An image display device comprising:
 - a display panel which has a plurality of pixel sections provided in the form of a matrix, each pixel section including at least a pixel having a transmissive region and a reflective

region for displaying ~~an~~ a first image for a first viewpoint and a pixel having a transmissive region and a reflective region for displaying ~~an~~ a second image for a second viewpoint;

 a lens disposed in front of the display panel, said lens being constituted by a plurality of lens elements for refracting light emitted from each pixel to output the light in different directions, each of said plurality of lens elements corresponding to each pixel section, a direction of refracting light from each pixel for said first image being different from a direction of refracting light from each pixel for said second image;

 a light source illuminating the transmissive region of said display panel with the light; and

 a reflection plate disposed in the reflective region of said display panel or in the rear of the reflective region of said display panel, said reflection plate having surface projections on the surface thereof for reflecting exterior light to said lens;

 wherein the focal distance f of said lens is different from the distance H between the surface of said reflection plate and the apex of said lens.

3. (withdrawn) An image display device according to Claim 1, wherein the focal distance f of said lens is smaller than the distance H between the surface of said reflection plate and the apex of said lens.

4. (withdrawn) An image display device according to Claim 2, wherein the focal distance f of said lens is smaller than the distance H between the surface of said reflection plate and the apex of said lens.

5. (withdrawn) An image display device according to Claim 3, wherein the focal distance f of said lens and the distance H between the surface of said reflection plate and the apex of the lens fulfill the following expression:

$$H/f \geq V/L + 1$$

where L is the pitch of convex portions on the surface of said lens in a first direction extending toward said pixel for displaying said image for said second viewpoint from said pixel for displaying said image for said first viewpoint and V is the minimum pitch of the surface projections in said reflection plate in said first direction.

6. (withdrawn) An image display device according to Claim 4, wherein the focal distance f of said lens and the distance H between the surface of said reflection plate and the apex of the lens fulfill the following expression:

$$H/f \geq V/L + 1$$

where L is the pitch of convex portions on the surface of said lens in a first direction extending toward said pixel for displaying said image for said second viewpoint from said pixel for displaying said image for said first viewpoint and V is the minimum pitch of the surface projections in said reflection plate in said first direction.

7. (withdrawn) An image display device according to Claim 5, wherein the focal distance f of said lens fulfills the following expressions in the case when an optimal observation distance of the three-dimensional image display device is OD ; an expanded projection width of the pixel at a distance of OD is e ; a refraction index of said lens is n ; and a pitch of the pixels in each of the pixel sections is P :

$$\beta = \arctan(e/OD)$$

$$\alpha = \arcsin(1/n \cdot \sin\beta)$$

$$f = P/\tan\alpha$$

8. (withdrawn) An image display device according to Claim 6, wherein the focal distance f of said lens fulfills the following expressions in the case when an optimal observation distance of the three-dimensional image display device is OD ; an expanded projection width of the pixel at a distance of OD is e ; a refraction index of said lens is n ; and a pitch of the pixels in each of the pixel sections is P :

$$\beta = \arctan(e/OD)$$

$$\alpha = \arcsin(1/n \cdot \sin\beta)$$

$$f = P/\tan\alpha$$

9. (withdrawn) An image display device according to Claim 5, wherein an optimal observation distance OD , an expanded projection width e of the pixel, a refraction index n of said lens, a distance H between the surface of said reflection plate and the center of the convex portion on the surface of the lens and a pitch P of the pixels in each of the pixel sections fulfill the following expressions:

$$\beta = \arctan(e/OD)$$

$$\alpha = \arcsin(1/n \cdot \sin\beta)$$

$$H = P/\tan\alpha$$

10. (withdrawn) An image display device according to Claim 6, wherein an optimal observation distance OD , an expanded projection width e of the pixel, a refraction index n of said

lens, a distance H between the surface of said reflection plate and the center of the convex portion on the surface of the lens and a pitch P of the pixels in each of the pixel sections fulfill the following expressions:

$$\beta = \arctan(e/OD)$$

$$\alpha = \arcsin(1/n \cdot \sin\beta)$$

$$H = P/\tan\alpha$$

11. (original) An image display device according to Claim 1, wherein a focal distance f of said lens is larger than a distance H between the surface of said reflection plate and the apex of the lens.

12. (original) An image display device according to Claim 2, wherein a focal distance f of said lens is larger than a distance H between the surface of said reflection plate and the apex of the lens.

13. (currently amended) An image display device according to Claim 11, wherein the focal distance f of said lens, the distance H between the surface of said reflection plate and the apex of the lens, said lens pitch L and the minimum pitch V of said surface projections fulfill the following expression:

$$H/f \leq -V/L + 1$$

where L is the pitch of convex portions on the surface of said lens in a first direction extending toward said pixel for displaying said second image for said second viewpoint from

said pixel for displaying said first image for said first viewpoint and V is the minimum pitch of the surface projections in said reflection plate in said first direction.

14. (currently amended) An image display device according to Claim 12, wherein the focal distance f of said lens, the distance H between the surface of said reflection plate and the apex of the lens, said lens pitch L and the minimum pitch V of said surface projections fulfill the following expression:

$$H/f \leq -V/L + 1$$

where L is the pitch of convex portions on the surface of said lens in a first direction extending toward said pixel for displaying said second image for said second viewpoint from said pixel for displaying said first image for said first viewpoint and V is the minimum pitch of the surface projections in said reflection plate in said first direction.

15. (previously presented) An image display device according to Claim 13, wherein an optimal observation distance OD, an expanded projection width e of the pixel, a refraction index n of said lens, the focal distance f of said lens and a pitch P of the pixels in each of the pixel sections fulfill the following expressions:

$$\beta = \arctan(e/OD)$$

$$\alpha = \arcsin(1/n \cdot \sin\beta)$$

$$f = P/\tan\alpha$$

16. (previously presented) An image display device according to Claim 14, wherein an optimal observation distance OD, an expanded projection width e of the pixel, a refraction index

n of said lens, the focal distance f of said lens and a pitch P of the pixels in each of the pixel sections fulfill the following expressions:

$$\beta = \arctan(e/OD)$$

$$\alpha = \arcsin(1/n \cdot \sin\beta)$$

$$f = P/\tan\alpha$$

17. (previously presented) An image display device according to Claim 13, wherein an optimal observation distance OD , an expanded projection width e of the pixel, a refraction index n of said lens, the distance H between the surface of said reflection plate and the apex of the lens and a pitch P of the pixels in each of the pixel sections fulfill the following expressions:

$$\beta = \arctan(e/OD)$$

$$\alpha = \arcsin(1/n \cdot \sin\beta)$$

$$H = P/\tan\alpha$$

18. (previously presented) An image display device according to Claim 14, wherein an optimal observation distance OD , an expanded projection width e of the pixel, a refraction index n of said lens, the distance H between the surface of said reflection plate and the apex of the lens and a pitch P of the pixels in each of the pixel sections fulfill the following expressions:

$$\beta = \arctan(e/OD)$$

$$\alpha = \arcsin(1/n \cdot \sin\beta)$$

$$H = P/\tan\alpha$$

19. (withdrawn) An image display device comprising:

a display panel in which a plurality of pixel sections in the form of a matrix, each pixel section including at least a pixel for displaying an image for a first viewpoint and a pixel for displaying an image for a second viewpoint;

a lens disposed in front of the display panel, said lens being constituted by a plurality of lens elements for refracting light emitted from each pixel to output the light in different directions; and

a reflection plate disposed in said display panel or in the rear of said display panel, said reflection plate having surface projections on the surface thereof for reflecting the exterior light to said lens;

wherein the focal distance f of said lens is the same as the distance H between the surface of said reflection plate and the apex of the lens, and

wherein the surface projections on the surface of said reflection plate is designed in such a way that the light entering the three-dimensional image display device is reflected plural times.

20. (withdrawn) An image display device comprising:

a display panel which has a plurality of pixel sections provided in the form of a matrix, each pixel section including at least a pixel having a transmissive region and a reflective region for displaying an image for a first viewpoint and a pixel having a transmissive region and a reflective region for displaying an image for a second viewpoint;

a lens disposed in front of the display panel, said lens being constituted by a plurality of lens elements for refracting light emitted from each pixel to output the light in different directions;

a light source illuminating said transmissive region of said display panel with the light; and

a reflection plate disposed in the reflective region of said display panel or in the rear of the reflective region of said display panel, said reflection plate having surface projections on the surface thereof for reflecting the exterior light to said lens;

wherein a focal distance f of said lens is the same as a distance H between the surface of said reflection plate and the apex of the lens, and

wherein the surface projections on the surface of said reflection plate is designed in such a way that the light entering the three-dimensional image display device is reflected plural times.

21. (withdrawn) An image display device according to Claim 19, wherein the inclination angle of said surface projection is 50° or more.

22. (withdrawn) An image display device according to Claim 20, wherein the inclination angle of said surface projection is 50° or more.

23. (withdrawn) An image display device according to Claim 1, wherein said lens is a lenticular lens.

24. (withdrawn) An image display device according to Claim 2, wherein said lens is a lenticular lens.

25. (withdrawn) An image display device according to Claim 19, wherein said lens is a lenticular lens.

26. (withdrawn) An image display device according to Claim 20, wherein said lens is a lenticular lens.

27. (withdrawn) An image display device according to Claim 1, wherein said lens is a fly-eye lens.

28. (withdrawn) An image display device according to Claim 2, wherein said lens is a fly-eye lens.

29. (withdrawn) An image display device according to Claim 19, wherein said lens is a fly-eye lens.

30. (withdrawn) An image display device according to Claim 20, wherein said lens is a fly-eye lens.

31. (withdrawn) An image display device comprising:
a display panel which has a plurality of pixel sections provided in the form of a matrix, each pixel section including at least a pixel for displaying an image for a first viewpoint and a pixel for displaying an image for a second viewpoint;

a lenticular lens disposed in front of the display panel, said lenticular lens being constituted by a plurality of cylindrical lenses for refracting light emitted from each pixel to output the light in different directions; and

a reflection plate disposed in said display panel or in the rear of said display panel, said reflection plate having surface projections on the surface thereof for reflecting exterior light to said lens;

wherein a probability of existence of an inclined surface having an inclination angle on said surface projections is uniform in each of said pixels in an array direction of said cylindrical lenses.

32. (withdrawn) An image display device comprising:

a display panel which has a plurality of pixel sections provided in the form of a matrix, each pixel section including at least a pixel having a transmissive region and a reflective region for displaying an image for a first viewpoint and a pixel having a transmissive region and a reflective region for displaying an image for a second viewpoint;

a lenticular lens disposed in front of the display panel, said lens being constituted by a plurality of cylindrical lenses for refracting light emitted from each pixel to output the light in different directions;

a light source illuminating the transmissive region of said display panel with the light; and

a reflection plate disposed in the reflective region of said display panel or in the rear of the reflective region of said display panel, said reflection plate having surface projections on the surface thereof for reflecting exterior light to said lens;

wherein a probability of existence of an inclined surface having an inclination angle on said surface projections is uniform in each of said pixels in an array direction of said cylindrical lenses.

33. (withdrawn) An image display device according to Claim 31, wherein a phase of said surface projections formed in one area of said pixels is shifted from a phase of said surface projections formed in another area of said pixels in said array direction of said cylindrical lenses.

34. (withdrawn) An image display device according to Claim 32, wherein a phase of said surface projections formed in one area of said pixels is shifted from a phase of said surface projections formed in another area of said pixels in said array direction of said cylindrical lenses.

35. (withdrawn) An image display device according to Claim 33, wherein a shift of said phase is a half the pitch of said surface projections.

36. (withdrawn) An image display device according to Claim 34, wherein a shift of said phase is a half the pitch of said surface projections.

37. (withdrawn) An image display device according to Claim 31, wherein the pitch of said surface projections in a longitudinal direction of said cylindrical lenses is smaller than the pitch of said surface projections in the array direction of said cylindrical lenses.

38. (withdrawn) An image display device according to Claim 32, wherein the pitch of said surface projections in a longitudinal direction of said cylindrical lenses is smaller than the pitch of said surface projections in the array direction of said cylindrical lenses.

39. (withdrawn) An image display device according to Claim 1, wherein said image for said first viewpoint is an image for the left eye and said image for said second viewpoint is an image for the right eye which has a parallax with respect to said image for the right eye to thereby provide a three-dimensional image.

40. (withdrawn) An image display device according to Claim 2, wherein said image for said first viewpoint is an image for the left eye and said image for said second viewpoint is an image for the right eye which has a parallax with respect to said image for the right eye to thereby provide a three-dimensional image.

41. (withdrawn) An image display device according to Claim 19, wherein said image for said first viewpoint is an image for the left eye and said image for said second viewpoint is an image for the right eye which has a parallax with respect to said image for the right eye to thereby provide a three-dimensional image.

42. (withdrawn) An image display device according to Claim 20, wherein said image for said first viewpoint is an image for the left eye and said image for said second viewpoint is an image for the right eye which has a parallax with respect to said image for the right eye to thereby provide a three-dimensional image.

43. (withdrawn) An image display device according to Claim 31, wherein said image for said first viewpoint is an image for the left eye and said image for said second viewpoint is an image for the right eye which has a parallax with respect to said image for the right eye to thereby provide a three-dimensional image.

44. (withdrawn) An image display device according to Claim 32, wherein said image for said first viewpoint is an image for the left eye and said image for said second viewpoint is an image for the right eye which has a parallax with respect to said image for the right eye to thereby provide a three-dimensional image.

45. (withdrawn) An image display device according to Claim 1, wherein said display device is a liquid crystal display device.

46. (withdrawn) An image display device according to Claim 2, wherein said display device is a liquid crystal display device.

47. (withdrawn) An image display device according to Claim 19, wherein said display device is a liquid crystal display device.

48. (withdrawn) An image display device according to Claim 20, wherein said display device is a liquid crystal display device.

49. (withdrawn) An image display device according to Claim 31, wherein said display device is a liquid crystal display device.

50. (withdrawn) An image display device according to Claim 32, wherein said display device is a liquid crystal display device.

51. (withdrawn) A portable terminal device including a three-dimensional image display device according to Claim 1.

52. (withdrawn) A portable terminal device including a three-dimensional image display device according to Claim 2.

53. (withdrawn) A portable terminal device including a three-dimensional image display device according to Claim 19.

54. (withdrawn) A portable terminal device including a three-dimensional image display device according to Claim 20.

55. (withdrawn) A portable terminal device including a three-dimensional image display device according to Claim 31.

56. (withdrawn) A portable terminal device including a three-dimensional image display device according to Claim 32.

57. (withdrawn) An image display device according to Claim 51, wherein said portable terminal device is a cellular phone, portable terminal, PDA, game machine, digital camera, or digital video camera.

58. (withdrawn) An image display device according to Claim 52, wherein said portable terminal device is a cellular phone, portable terminal, PDA, game machine, digital camera, or digital video camera.

59. (withdrawn) An image display device according to Claim 53, wherein said portable terminal device is a cellular phone, portable terminal, PDA, game machine, digital camera, or digital video camera.

60. (withdrawn) An image display device according to Claim 54, wherein said portable terminal device is a cellular phone, portable terminal, PDA, game machine, digital camera, or digital video camera.

Amendment under 37 C.F.R. §1.116
U.S. Application No. 10/787,144

61. (withdrawn) An image display device according to Claim 55, wherein said portable terminal device is a cellular phone, portable terminal, PDA, game machine, digital camera, or digital video camera.

62. (withdrawn) An image display device according to Claim 56, wherein said portable terminal device is a cellular phone, portable terminal, PDA, game machine, digital camera, or digital video camera.